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A COMPARISON OF TYPES OF CONTAINERS, REFRIGERATION, AND LOADS IN THE TRANSPORTATION OF NON-PRECOOLED NAVEL ORANGES IN HALF-BOX FIBERBOARD CARTONS FROM CENTRAL CALIFORNIA TO CHICAGO AND NEW YORK
DECEMBER 1952 and JANUARY 1953

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A Comparison of Types of Containers, Refrigeration, and Loads in the Transportation of Non-Precooled Navel Oranges in Half-Box Fiberboard Cartons from Central California to Chicago and New York
December 1952 and January 1953

Introduction

This is a report on rail shipping tests with navel oranges from Central California made as a further study of transit refrigeration of oranges in cartons (see H.T.&S. Office Reports Nos. 281 and 283). In the second of the preceding references it was demonstrated that oranges precooled to around 40° F. before or after packing in cartons, present no especial difficulty in transit refrigeration. However, the question as to practical methods of obtaining satisfactory cooling of warm oranges in cartons after loading had not been answered. Therefore, the study here reported deals with the transportation of warm (non-precooled) oranges in cartons.

Previous experience with shipments of warm oranges in both ventilated and non-ventilated cartons had indicated that greater benefit from transit refrigeration might be expected by the use of a vented type of carton. Accordingly, this series of shipping tests was for the purpose of determining the rate and amount of cooling in commercial loads as affected by vented and non-vented cartons; solid and chimney loads; ice refrigeration and combination ventilation, with and without CIC ("cooling in car" before departure); wood and metal floor racks; wall flues; cartons loaded flat or on end; and the influence of outside temperatures in transit.

The results reported here may serve little more than to emphasize the difficulties in obtaining adequate refrigeration in carloads of warm oranges in cartons which offer considerable resistance to the conventional aids in cooling. To obtain an adequate evaluation of these factors would have required more test shipments than were obtainable this winter in Central California, as the volume of navel oranges shipped in cartons was less than anticipated, due to shortages in supply of cartons or special packing equipment.

Description of Tests

The series of tests consisted of six shipments of two cars each. All test cars were equipped with Preco fans, but there was considerable diversity in respect to a number of other equipment items and in their handling. These details are presented in the notes on individual tests, and also in Table 1 and Charts 1-12.

Temperatures in the test loads were obtained by means of Ryan recording thermometers. These were wrapped in plastic bags and placed in the center of the cartons at each of the following positions in the load; middle and top quarterlength, centerline; middle and bottom quarterlength, north side; middle doorway, centerline; and middle doorway, north side. Two cars carried an additional Ryan thermometer at bottom doorway, north side. Outside air temperatures were obtained by a Ryan thermometer underneath one car in each test. These records are presented in Table 2 and Charts 1-12.

Notes on individual tests and cars

Particular attention should be given to the temperature at the middle quarterlength centerline position (MQ CL) since it represents much of the load and unfavorably high temperatures there indicate a potential danger for "weak" oranges. An early lowering of temperature at this position is desirable, hence the mention of MQ CL temperatures at Ogden and Belen in the following notes.

Test 1. December 3, 1952. To New York via SP-UP. Sunland Packing Company. The principal comparison in Test No. 1 was between combination ventilation and preiced refrigeration with vented cartons.
Average outside temperature en route was 43° F.

Car A. PFE 63531. No wall flues. Wood floor racks. Vents open to Ogden, Standard ventilation beyond.

Loaded December 2-3. Vented cartons, IP-10*, solid load. Loading temperature 69° F. Average load temperature reduced to about 50° before Ogden, followed by a slow rise until unloaded, December 14. The Ryan thermometer at MQ CL failed, but the position was probably somewhat higher than MQ NS (53°) at Ogden. (Chart 1)

Car B. PFE 63747. No wall flues. Wood floor racks. PI-REPL-DNR.

Loaded December 2 but held about 36 hours for Car A. Vented cartons, IP-10*, solid load. Loading temperature 69° F. Load temperature was reduced to about 50° before Ogden, and continued to drop to about 40° at unloading, December 14. At Ogden the MQ CL position was 54°. (Chart 2)

Test 2. December 4. To New York via SFe. Strathmore District Orange Association. The principal comparison in Test No. 2 was between ventilated cartons loaded flat and with chimneys, and loaded on end without chimneys.
Average outside temperature en route was 41° F.

Car C. SFRD 8338. No wall flues. Wood floor racks. Night air cooled, seven hours. Vents open to Belen, Standard ventilation beyond.

Loaded December 4. Vented cartons, IP-10*. Three rows of 4-unit chimneys. Loading temperature, 72° F. Average temperature of load was reduced to about 55° before Belen and the reduction continued slowly and was in the lower 40s at unloading December 15. At Belen the MQ CL position was 62°. (Chart 3)

* Manufacturers designation of carton type

Car D. SFRD 11031. No wall flues. Metal floor racks. Cooled seven hours with fans and outdoor night air. Vents open to Belen, Standard ventilation beyond.

Loaded December 4. Vented cartons, IP-10. Cartons on end. Solid load. Loading temperature 72° F. Average load temperature was reduced to about 49° before Belen and to about 38° at unloading December 14. At Belen MQ CL position was 55°. Car D gave the second or third best refrigeration performance of the twelve test cars. However, there were two principal variables in Test No. 2: (a) Cartons flat with chimneys and cartons on end without chimneys, and (b) wood and metal floor racks. The former comparison was the one intended, but on account of the later situation the difference in refrigeration performance of Car C and D cannot be attributed entirely to the load type. (Chart 4)

Test 3. December 5. To New York via SFe. Visalia Citrus Association. The principal comparison in Test No. 3 was between vented and non-vented carton loads.
Average outside air temperature en route was 38° F.

Car E. SFRD 15141. No wall flues. Wood floor racks. Vents open to Belen, Standard ventilation beyond.

Loaded December 5-6. Vented cartons. IP-10. Three rows of 4-unit chimneys. Loading temperature 79° F. Average temperature of load was reduced to only about 57° before Belen and decreased steadily to about 44° at unloading, December 16. At Belen the MQ CL position was 57° and the MQ NS 66°.

The higher MQ NS temperature probably was due to the Ryan being in a carton in the "extra row" at the north side and thus one carton farther from a chimney than the Ryan at the MQ CL position. The situation was the same in Car F. Doorways were loaded solid in both cars. (Chart 5)

Car F. SFRD 15167. No wall flues. Wood floor racks. Vents open to Belen, Standard ventilation beyond.

Loaded December 5 but held about 30 hours until Car E was loaded. Non-vented cartons. IP-8. Three rows of 4-unit chimneys. Loading temperature 78° F. Average temperature of the load was reduced to about 68° before Belen and between 50-55° at unloading, December 16. At Belen the MQ CL position was 70°, and the MQ NS 79°. (Chart 6)

Test 4. December 9. To New York via SP-UP. Sunland Packing Company. The principal comparison in Test 4 was between the solid and chimney loads with wall flues.
Average outside air temperature en route was 40° F.

Car G. PFE 68490. Wall flues. Wood floor racks (without holes through floor boards). Vents open to Ogden, Standard ventilation beyond.

Loaded December 9-10. Vented cartons, IP-10. Three rows of 4-unit chimneys. Loading temperature 67° F. Average load temperature reduced to about 55° before Ogden, but there was very little further reduction until near destination. Unloaded, December 18. At Ogden the MQ CL position was 59°. (Chart 7)

Car H. PFE 66781. Wall flues. Wood floor racks as in Car G. Vents open to Ogden, Standard ventilation beyond.

Loaded December 9, but held about 36 hours until Car G was loaded. Vented cartons, IP-10. Solid load. Loading temperature, 67° F. Load temperatures were widespread, especially before Ogden. At the end of the second day after loading (about 56 hours, 40 of which was standing time) the MQ CL thermometer registered 80° and the MQ NS, 76°, while the average temperature at Ogden was about 62°. The MQ CL and MQ NS positions registered 77° and 70°, respectively, at Ogden, but the other four positions had lowered to an average of about 56°. After Ogden the load temperatures continued downward so that at unloading, December 18, the average temperature was about 50°. The vents on this and Car G were closed between Ogden and Marion, Ohio. (Chart 8)

Test 5. January 20 and 21, 1953. To New York via SFe. Sunland Packing Company. The original purpose of Test 5 was the comparison of ventilated and non-ventilated cartons. However, the delivered test cars were dissimilar in that one had wall flues and the other not.

Average outside air temperature en route was 38° F.

Car I. SFRD 11182. No wall flues. Metal floor racks. Night air cooled 24 hours (two nights). Initially iced.

Loaded January 20, but held 36 hours until Car J was loaded. Non-vented cartons. Lv-2 (corner posts). Three rows of 4-unit chimneys. Loading temperature 68° F. Average load temperatures reduced to about 58° before Belen with a continued slow drop in temperature into the 40's at unloading, February 2. At Belen the MQ CL position was 65°. (Chart 9)

Car J. SFRD 12782. Electric fans (all other test cars had "floor fans"). Wall flues. Metal floor racks. Night air cooled 12 hours. Initially iced.

Loaded January 21. Vented cartons. K-4 (slotted). Side flaps of carton closed first, ends then folded on top allowing small slit 1/2 by 6 1/2 inches along center of top. Three rows of 4-unit chimneys. Loading temperature 70° F. Average temperature of the load was reduced to near 55° before Belen and further reduced into the lower 40's at unloading, February 2. At Belen the temperature at the MQ CL position was 61°. This car carried an extra Ryan recording thermometer in the BD NS position where the temperature was nearly the same as at the BQ NS position. (Chart 10)

Test 6. January 21. To New York and Chicago via SFe. Strathmore District Orange Association. The principal purpose of Test 6 was the comparison of cars with and without wall flues. Average outside air temperature en route for Car K was 40° and for Car L was 39°.

Car K. SFRD 11883. New York. Wall flues. Metal floor racks. PI-REPL-IRI. CIC 8 hours. Carried extra Ryan recording thermometer in BD NS position where the temperature was almost the same as at the BQ NS position.

Loaded January 21. Non-vented cartons. LV-2 (corner posts). Three rows of 4-unit chimneys. Loading temperature, 70° F. Load temperatures widely spread, as much as 20° difference between MQ CL and top or bottom positions. The cooling in car operation did not noticeably affect the MQ CL position instead the temperature rose to 75° during this time and remained so for about 40 hours before starting downward. It was still 70° at Belen. The MD CL position was 66°. The average temperature of the load at Belen was about 58°. (Chart 11)

Car L. SFRD 10816. Chicago. No wall flues. Metal floor racks. PI-REPL-DNR, CIC 8 hours.

Loaded January 21. Non-vented cartons. LV-2. Three rows of 4-unit chimneys. Loading temperature, 68° F. There was not so much spread in the temperatures of the load as in Car K and generally the refrigeration performance was better. Average temperature of the load at Belen was about 57° and the MQ CL position was 64°. The effect of the wall flues on this situation is not clear. Car K unloaded February 1 and Car L February 2, the latter having stood in the Chicago yards seven days.

Load condition at destination

Examination of the R.P.I.A. (Railroad Perishable Inspection Agency) reports on load condition of the twelve test cars showed that all of them regardless of type of carton and arrangement arrived with loads generally intact. In most of the cars there was some slight tilting or shifting which resulted at times in considerable slight creasing in the middle of the cartons and depression of the covers and also some slight rubbing. In one instance five cartons at the doorway were badly crushed by the weight of the upper layers, otherwise the damage to the cartons was of slight if any commercial importance and no recoopering was required. A few damp cartons were reported in most of the cars. This moisture occurred usually immediately over the fan housings, or at bunker end walls and adjacent side walls, and in one car for considerable area on floor racks. The damp cartons maintained their rigidity and apparently soon dried and stacked well eight high on the pier.

Fruit condition

The reports of fruit condition in the test cars were all generally favorable. "Fruit in good condition, firm", seems to apply to fruit from all test cars. Color was "good", with some reported under color. No decay was reported in eight test cars. One car was reported, "an occasional blue mold decay" and another, "only one orange found decayed." Of the two remaining cars one was reported "less than 1 percent decay" and the other "an average of 1 percent decay, ranging from sound to 3 percent." For most of the loads the stem buttons were noted as fresh and green. Exceptions were, "buttons mostly green some dry and withered", "buttons mostly withered and easily detached", and "stem buttons generally withered but firmly attached". These exceptions occurred in five of the test cars.

Discussion

The comparisons included in this series of shipping tests may be reviewed as follows:

a. Vented vs. non-vented cartons. Evidence comes from Test No. 3 (Cars E and F) and Test No. 5 (Cars I and J). Also from the general results of the series as a whole.

Car E carried vented (IP-10) and Car F non-vented (IP-8) cartons. The refrigeration performance of Car E was definitely better than the latter. It ranked about fifth among the twelve test cars and Car F gave definitely the poorest performance in the series. However, it should be noted that Car F was held for 30 hours after loading so it could leave at the same time as Car E and have the same transit weather conditions.

The temperaturesin Car J which was loaded with vented (K-4) cartons were generally lower than the temperatures in Car I with non-vented (Lv-2) cartons. Also Car I was held over for about 36 hours while Car J was being loaded.

The general results indicate clearly a refrigeration advantage for vented cartons over non-vented cartons. Lower temperatures were finally attained in vented carton loads, not only in the present series of tests, but also in previous tests involving warm orange shipments. The general results of the present tests bring out another point in connection with the advantage of vented cartons that is of current interest to shippers which is the effect of type of load which is discussed in the following paragraphs.

b. Solid vs. chimney loads. Tests No. 2 (Cars C and D) and No. 4 (Cars G and H) provide a comparison of solid and chimney loads. Cars C and D present some complications in that Car D was equipped with metal floor racks and the cartons were loaded on end, whereas Car C had wood floor racks and the cartons were loaded flat. Both of these items may have been of advantage to Car D. The refrigeration performance of Cars C and D were very similar, except that before Belen, the temperature recorded in the MQ CL position of Car C was several degrees higher than the same position in Car D, even though Car C carried the chimney load.

The records of Car G and H show some advantage for the chimney load, but the delay of Car H for 36 hours after loading should be taken into consideration. However, Car H with solid load gave the second poorest refrigeration performance of the twelve test cars. During the fourth and fifth days after loading its MQ CL position was 18° warmer than that of Car G.

Some very good evidence of the benefit of chimneys was obtained from Cars E and F. They were both chimney loads but one had vented and the other of non-vented cartons. Both carried the "extra row" against the north side in which the Ryans for the MQ NS position were placed. The Ryans were consequently one carton farther from a chimney than those in the MQ CL position. At Belen the MQ NS of the two cars were 9° and 8° F. warmer than the MQ CL's. These were the only test cars having middle wall temperatures higher than middle centerline. The doorways of these cars were loaded solid and the MD NS temperatures in both cars were cooler than the MD CL as is normally the case.

The general results of the tests as a whole also favor the chimney load. The twelve test cars included four each of three types of loads: vented cartons in solid loads; vented cartons in chimney loads; and non-vented cartons in chimney loads. The load temperature records taken manually at time of unloading (see Table 3) (except Car L for which tape recorded temperatures were used) may be summarized as follows:

		Fruit Temperatures			
		Top	Middle	Bottom	Total average for each group
Vented cartons in Solid loads	Car A	48°	56°	46°	
	Car B	41°	42°	40°	
	Car D	39°	42°	40°	
	Car H	41°	47°	47°	
Average		42 (+5)*	47 (+4)*	43	44°
Vented cartons in Chimney loads	Car C	38°	42°	38°	
	Car E	40°	42°	40°	
	Car G	39°	42°	43°	
	Car J	43°	43°	38°	
Average		40 (+2)*	42(+2)*	40	41°
Non-vented cartons in Chimney loads	Car F	43°	49°	47°	
	Car I	44°	47°	37°	
	Car K	44°	47°	39°	
	Car L	48°	52°	43°	
Average		45 (+4)*	49 (+7)*	42	45°

* Difference between middle and top or bottom temperatures.

This summary for the three groups of cars indicate an advantage for both chimney loads and vented cartons. From these data one may assume that the refrigeration performance of non-vented cartons in chimney loads is about equivalent to vented cartons in solid loads, and that vented cartons in chimney loads have some advantage. The average top, middle and bottom temperatures for the three groups show that the middle temperatures were higher than the tops and bottoms. They also show a greater difference for both vented cartons in solid loads and non-vented cartons in chimney loads than for vented cartons in chimney loads.

c. **Wall flues vs. no flues.** In test No. 6 the cars (Cars K and L) were loaded with non-vented (Lv-2) cartons and received preicing service. In transit, Car K, with wall flues, always had higher middle centerline temperatures than

Car L, without wall flues, (average difference about 8° F.) Also Car K always showed a greater spread of temperatures between middle centerline and middle north side positions than Car L. The MQ CL position in Cars K and L were always warmer than the corresponding north side positions, the average difference was about 14° and 4°, respectively. The differences in temperature between MD CL and MD NS was about 6° and 3°, respectively.

The fact that the car without wall flues showed the better refrigeration performance, and that its wall positions were cooler, indicated a disadvantage of wall flues, on account of circulating air being shunted around rather than through the load.

For shipments of non-precooled oranges in cartons it is probably correct to state that no advantage in transit refrigeration should be expected from wall flues during the wide temperature ranges commonly experienced in summer and winter. This statement regarding wall flues differs substantially from one previously made in connection with shipments of precooled oranges in cartons (H.T.&S. Office Report No. 283, p. 6), when the main object was to maintain the loading temperatures uniformly in transit. Although no benefit from wall flues was noted in the present tests, the supposition remains that they would be a factor in protection of non-precooled oranges in cartons next to the walls during the extremely hot or subzero weather.

d. Wood vs. metal floor racks. No definite information was obtained in these tests on the relative value of wood and metal floor racks in transit refrigeration. It seemed possible that because of the more open construction of metal floor racks there would be less obstruction to the very limited channels of circulation through carton loads and hence they would show some superiority over the wooden racks.

e. Ice refrigeration vs. ventilation. In Test No. 1, Car B was preiced and replenished and Car A had vents open to Ogden. Owing to the failure of the Ryan thermometer in the indicative MQ CL position of Car A only an approximate comparison could be made between the refrigeration performance of the two cars. Car B was considered perhaps as having made the best showing of the series, but as far as Ogden both apparently behaved essentially alike. Vents on Car A were closed during a subfreezing period just east of Ogden, thus further cooling was checked. Afterwards its vents were open four days across the central states when the average outside temperature was about 49° F., and which for forty hours was higher than its load temperature. Due to these temperature conditions the average load temperature increased a few degrees in transit after Ogden, while the temperature in Car B, with vents closed, continued to decrease.

Two other cars (K and L) were preiced, replenished, and precooled 8 hours with car fans, two cars were initially iced (I and J), and the remaining seven cars moved under ventilation. The initially iced cars and two ventilated cars also received "night air" cooling.

Careful comparisons of the performances of the iced and ventilated cars do not seem to disclose any significant differences between ice refrigeration and ventilation or added "night air" cooling. Some differences were noted that might be attributed to one service or another, but the results of this series of tests suggest that none of the services employed were adequate for the production of a desirable cooling rate during the first and most important portion of the journey, namely, to Ogden or Belen, the first four days after loading. The loading temperatures of the test cars ranged from 67° F. to 79° with an average of 71°. The indicative middle quarter centerline positions for each car at Ogden or Belen showed a temperature range of 54° to 77°, with an average of 64°. After these four days in transit the MQ CL positions in three cars showed temperatures as high or higher than their loading temperatures. The averages for this position in the loads from loading to Ogden or Belen (not including the loading temperature) ranged from 61° to 81°, with a general average of 69°. Cars H and F had the highest temperatures, the former with an average of 79.3° from a loading temperature of 67°, and the latter with an average of 81.1° from a loading temperature of 78°.

The unloading temperatures of most test loads were unexpectedly low and in themselves indicated excellent transit refrigeration (see Table 3), but when the forepart of their journey is taken into account, one must question the value of unloading temperatures for giving a complete enough transit refrigeration picture when non-precooled oranges in cartons are concerned.

The results no doubt would have been more favorable for several test cars if the loading time had not been so long. Also the 30 to 36 hours holding of Cars F, H and I after loading contributed to their poor performance. Prompt loading and departure seems especially urgent for carton shipments of non-precooled oranges.

f. Outside temperatures in transit. The six shipping tests encountered somewhat milder transcontinental temperatures than previously recorded general averages for December and January. The range of minima for the tests was 12° to 24° F., and the range of average outside temperatures was 38° and 43°. The number of hours below 32°, including standing time at destination, ranged from 21 and 24 for Tests Nos. 2 and 1 to 51 , 57 . 48 and 84 for Tests Nos. 6, 4, 5, and 3, respectively. The differences in outside air temperatures encountered by the individual tests seem too small for further consideration.

Conclusion

The purpose of the present shipping tests was not only to obtain further information on transit refrigeration in commercial loads of warm (non-precooled) oranges in cartons but especially to determine to what extent vented types of cartons would alleviate the recognized difficulty of cooling non-vented all-carton loads. The results show an advantage of vented over non-vented cartons even though the venting provided by the former is meager. The chimney as compared with the solid types of loading also showed an advantage. Vented cartons in a chimney load was an especially desirable combination.

However, in consideration of the slow rate of cooling in transit at the critical middle quarter centerline position in all test loads, it may be stated that no combination of cartons with load patterns or refrigeration services proved satisfactory.

A very practical point against the above conclusion is that all shipments reached destination in reported good condition. This apparent contradiction is due to a number of factors. So many in fact that no definite temperature has been given as optimum for the transportation of oranges. Nevertheless there has been a general understanding that non-precooled oranges should be cooled to 45° -- 50° F. by the third or fourth day in transit, to insure reasonable safety for the "weaker" lots which are frequently shipped due to seasonal and other conditions. These lots must be included in over-all recommendations of transit temperatures. Of course "strong" early or mid-season oranges are not likely to show injury by any transit temperature, but this situation cannot be the basis for recommendations.

As a post script to this report Chart 13 is presented. It shows typical examples of what has been considered good transit refrigeration for non-precooled oranges in standard boxes and precooled oranges in cartons to allow comparison with the refrigeration obtained in the present tests with non-precooled oranges in cartons.

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Mike Bunda of Sunkist Growers, Inc., assisted in the inspection of fruit in New York.

One of the test cars was met, reported on and its test equipment recovered by Dr. G. B. Ramsey, Principal Pathologist, U. S. Department of Agriculture, Chicago, Illinois.

TABLE 1

Summary of Services, Equipment, and Temperatures for 12 Test Cars of Navel Oranges in Cartons
December 1952-January 1953

	PI REPL	Re-icing	Vents open 1/	Nite air cooling	Pre-cooled	Wall flues	Floor racks	Carton		Type Load	Av. Out-side air	Av. load-ing temp.	MQ CL		MD CL	
								vent.	non-vent.				Av. to Belen 2/	Av. to unload-ing 3/	Av. to Belen 2/	Av. to unload-ing 3/
A	-	-	x	-	-	no	wood	IP-10	-	solid	43	69	-	-	58	51
B	x	DNR	-	-	-	no	wood	IP-10	-	solid	43	69	64	40	57	40
C	-	-	x	7 hrs.	-	no	wood	IP-10	-	chimney	41	72	67	48	58	42
D	-	-	x	7 hrs.	-	no	metal	IP-10	-	solid on end	41	72	62	46	57	42
E	-	-	x	-	-	no	wood	IP-10	-	chimney	38	79	61	49	68	51
F	-	-	x	-	-	no	wood	-	IP-8	chimney	38	78	81	65	80	60
G	-	-	x	-	-	yes	wood	IP-10	-	chimney	40	67	66	53	65	52
H	-	-	x	-	-	yes	wood	IP-10	-	solid	40	67	79	66	65	50
I	-	II	-	24 hrs.	-	no	metal	-	Lv-2	chimney	39	68	70	53	60	43
J	-	II	-	12 hrs.	-	yes	metal	K-4	-	chimney	39	70	68	51	66	48
K	x	Argen-tine	-	-	8 hrs.	yes	metal	-	Lv-2	chimney	40	70	73	59	68	51
L	x	DNR	-	-	8 hrs.	no	metal	-	Lv-2	chimney	39	68	68	56	66	46

1/ Vents billed open to Ogden on SP-UP route; to Belen on Santa Fe route.

2/ Average temperature from departure to Ogden or Belen as the case may be.

3/ Average temperature from Belen or Ogden to unloading.

II Initial icing.

Table No. 2.

Ryan Thermometer Transit Temperatures To Unloading

Test No. 1 Car A.

December	1/ 2	3	2/ 4	5	6	7	8	9	10	11	Average for 10 days	12	13	14
TQ CL	72	69	65	56	45	49	48	49	52	54	56	54	54	54
MQ CL	71	71	Ryan failed											
MQ NS	70	69	67	63	54	49	47	48	50	53	57	53	53	52
BQ NS	70	61	59	62	57	52	48	48	49	51	56	51	48	45
MD CL	70	60	62	58	49	47	47	49	51	53	55	54	54	54
MD NS	69	60	61	58	50	47	47	48	50	52	54	53	53	51

Test No. 1 Car B.

December	1/ 2	3	2/ 4	5	6	7	8	9	10	11	Average for 10 days	12	13	14
TQ CL	Ryan failed													
MQ CL	69	70	68	64	54	47	42	40	40	39	53	39	39	39
MQ NS	72	73	69	64	55	48	43	42	41	41	55	41	41	41
BQ NS	68	57	54	57	54	49	43	41	41	39	50	39	39	39
MD CL	69	67	63	56	47	42	40	39	39	39	50	39	39	39
MD NS	70	65	61	55	46	42	39	39	39	39	50	39	40	40

Test No. 2 Car C

December	4	5	6	7	8	9	10	11	12	13	Average for 10 days	14	15
TQ CL	74	63	60	45	47	47	45	42	41	42	51	43	43
MQ CL	78	74	73	63	55	52	51	48	45	45	58	45	45
MQ NS	72	69	68	57	50	48	47	46	44	43	54	43	43
BQ NS	69	65	63	56	50	48	47	44	43	41	53	40	39
MD CL	72	67	63	52	46	46	45	43	40	40	51	40	39
MD NS	70	70	69	58	51	49	48	46	45	43	55	43	43

Test No. 2 Car D

December	4	5	6	7	8	9	10	11	12	13	Average for 10 days	14	15
TQ CL	69	57	52	40	43	44	43	40	39	39	47	39	
MQ CL	73	68	67	57	51	49	48	46	44	44	55	44	
MQ NS	70	60	55	43	38	41	41	40	38	37	46	38	
BQ NS	70	60	57	47	43	43	44	41	39	39	48	39	
MD CL	69	63	60	53	46	44	44	44	41	40	50	40	
MD NS	65	49	48	41	42	43	42	38	37	37	44	37	

1/ Loading 2/ Departure

Table No. 2
Con't.

Ryan Thermometer Transit Temperatures To Unloading

Test No. 3 Car E

December	5	6	7	8	9	10	11	12	13	14	Average for 10 days	15	16
TQ CL	77	75	68	56	44	43	42	40	41	41	53	42	41
MQ CL	80	79	76	71	62	55	51	50	49	46	62	45	45
MQ NS	80	81	80	77	71	63	59	56	53	49	67	48	46
BQ NS	80	75	69	67	64	59	55	52	49	47	62	45	43
MD CL	80	74	72	69	62	56	53	52	50	48	62	48	48
MD NS	74	70	67	64	59	53	50	48	46	45	58	44	43

Test No. 3 Car F

December	5	6	7	8	9	10	11	12	13	14	Average for 10 days	15	16
TQ CL	72	70	68	Ryan failed									46
MQ CL	82	84	86	83	75	70	67	65	64	62	74	62	62
MQ NS	78	80	83	84	81	75	70	67	64	61	74	58	56
BQ NS	80	77	73	72	66	62	60	57	55	54	66	53	50
MD CL	80	83	85	82	75	68	65	62	61	58	72	57	57
MD NS	79	76	75	71	63	57	55	53	52	49	63	48	47

Test No. 4 Car G

December	9	10	11	12	13	14	15	16	17	18	Average for 10 days
TQ CL	67	67	64	59	51	52	53	53	45	41	55
MQ CL	68	68	69	66	59	55	54	54	51	47	59
MQ NS	71	71	69	66	58	55	54	53	51	48	60
BQ NS	67	63	61	61	56	55	54	53	49	46	57
MD CL	68	67	68	67	58	54	53	53	53	52	59
MD NS	65	65	65	62	55	52	52	52	48	44	56

Test No. 4 Car H

December	9	10	11	12	13	14	15	16	17	18	Average for 10 days
TQ CL	68	68	69	64	57	56	56	56	50	45	59
MQ CL	69	74	80	80	77	73	68	66	63	59	71
MQ NS	69	72	76	75	70	67	64	62	60	55	67
BQ NS	70	69	67	64	55	56	57	57	51	45	59
MD CL	68	70	70	65	55	52	52	52	49	44	58
MD NS	71	72	72	68	60	57	56	56	51	46	61

Table No. 2
Con't.

Ryan Thermometer Transit Temperatures
To Unloading

Test No. 5 Car I

January	20	21	22	23	24	25	26	27	28	29	Average for 10 days	30	31	1	2
TQ CL	68	68	68	62	54	49	46	45	43	43	55	43	44	44	45
MQ CL	70	71	74	73	68	63	59	57	53	53	64	51	50	49	49
MQ NS	70	72	73	71	65	60	56	53	50	49	62	-	-	-	-
BQ NS	70	68	65	60	54	49	47	45	43	42	54	41	40	40	40
MD CL	68	68	66	63	57	52	48	45	43	42	55	41	41	41	41
MD NS	71	73	75	74	67	61	56	52	49	47	63	46	45	45	44

Test No. 5 Car J

January	21	22	23	24	25	26	27	28	29	30	Average for 10 days	31	1	2
TQ CL	72	66	53	44	42	40	38	38	41	43	48	43	44	
MQ CL	74	73	71	64	59	56	53	50	50	49	60	48	46	
MQ NS	72	71	68	61	54	51	47	44	43	43	55	43	41	
BQ NS	68	65	59	52	49	45	43	40	40	38	50	38	37	
MD CL	71	69	68	63	58	54	51	48	47	46	58	45	44	
MD NS	70	69	63	55	50	46	43	42	42	41	52	40	40	
BD NS	67	66	59	53	48	46	43	42	41	38	50	37	37	

Test No. 6 Car K

TQ CL	71	65	60	56	53	49	47	46	45	46	54	46	46
MQ CL	72	75	75	73	69	65	62	60	58	56	67	55	55
MQ NS	69	67	64	59	54	51	48	46	44	44	55	44	44
BQ NS	69	62	56	52	49	46	43	43	41	40	50	39	39
MD CL	72	68	69	68	65	61	55	51	48	47	60	46	45
MD NS	69	66	65	61	58	54	50	46	44	43	56	42	42
BD NS	70	62	57	54	50	48	45	43	41	39	51	38	38

Test No. 6 Car L

TQ CL	67	63	57	53	50	50	49	48	48	48	53	48	49	46
MQ CL	69	71	70	66	63	61	58	57	56	55	63	53	52	52
MQ NS	65	66	66	64	60	57	55	53	51	50	59	48	47	45
BQ NS	67	63	58	56	53	51	48	45	42	41	52	41	39	39
MD CL	69	70	69	63	57	52	49	46	44	43	56	41	41	41
MD NS	69	66	64	57	52	49	45	44	42	41	53	40	40	41

TABLE 3

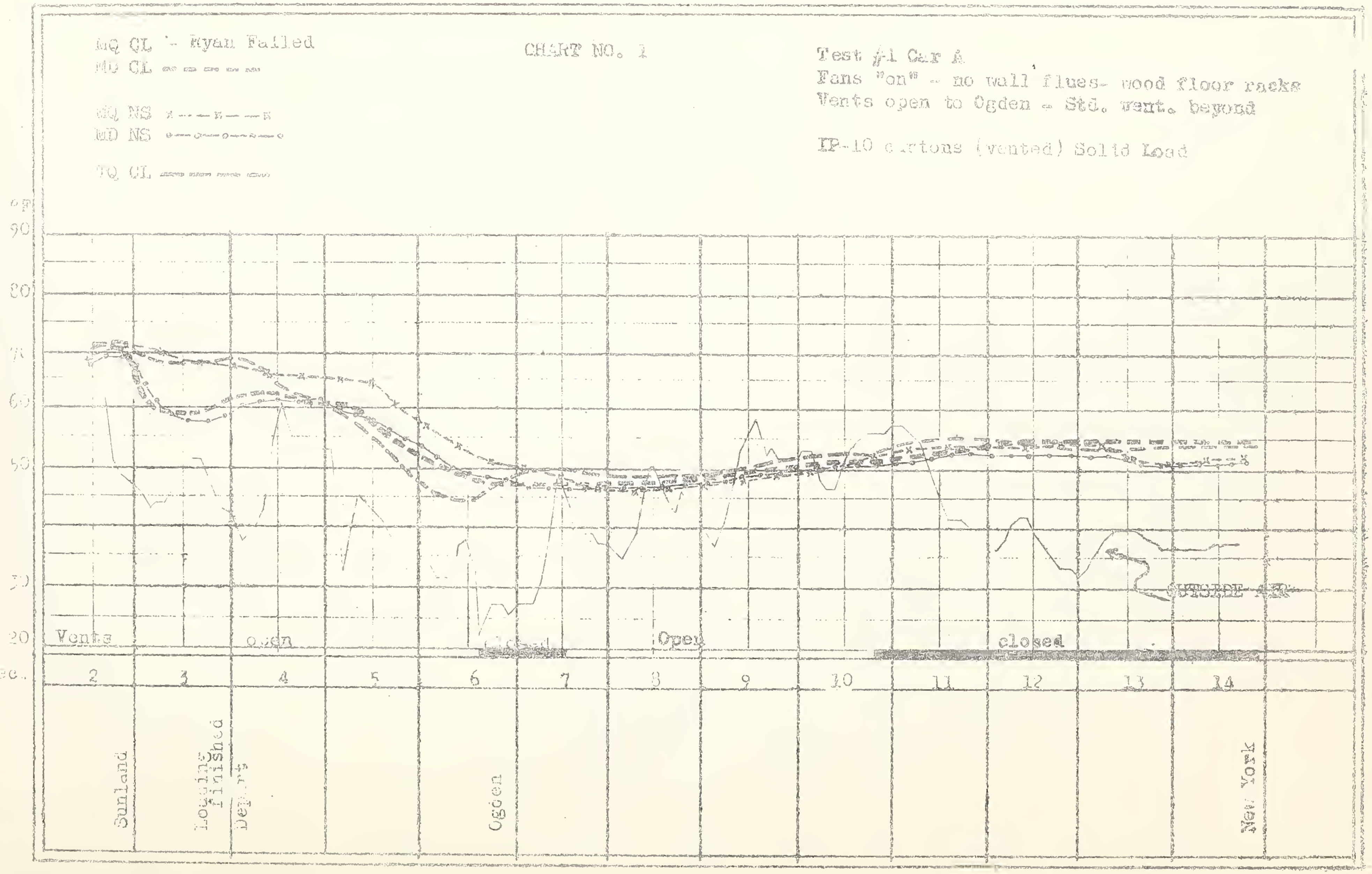
Fruit Temperatures Taken Manually at Unloading

Test No.	Car	Top layer a	b	c	d	e	Middle layer a	b	c	d	e	Bottom layer a	b	c	d	e
1	A	48	46	46	49	52	48	52	[illegible]	52	54	42	48	48	44	48
	B	42	39	42	40	40	42	41	43	41	41	40	40	38	43	40
2	C	39	38	33	38	34	39	45	40	45	42	34	42	34	40	38
	D	39	39	38	39	42	43	42	39	40	44	40	40	38	43	40
3	E	40	41	39	42	40	40	42	40	45	42	38	42	39	43	40
	F	43	43	42	44	42	44	52	47	51	49	43	51	45	49	48
4	G	38	39	38	39	39	40	43	43	42	44	39	44	43	46	44
	H	39	42	40	42	41	40	43	43	58	51	39	47	41	61	49
5	I	39	43	44	45	47	38	45	50	47	55	36	37	39	37	37
	J	39	43	44	42	45	40	42	47	41	43	37	36	38	37	44
6	K	40	43	47	44	48	40	44	54	46	42	37	40	39	39	41
	L*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

* No record

a = Doorway at wall
b = "A" end, quarterlength centerline row
c = "A" end, quarterlength wall row
d = "B" end, quarterlength centerline row
e = "B" end, quarterlength wall row

CHART NO. 1



Test #1 Car A
Fans "on" - no wall flues- wood floor racks
Vents open to Ogden - Std. vent. beyond

IP-10 cartons (vented) Solid Load

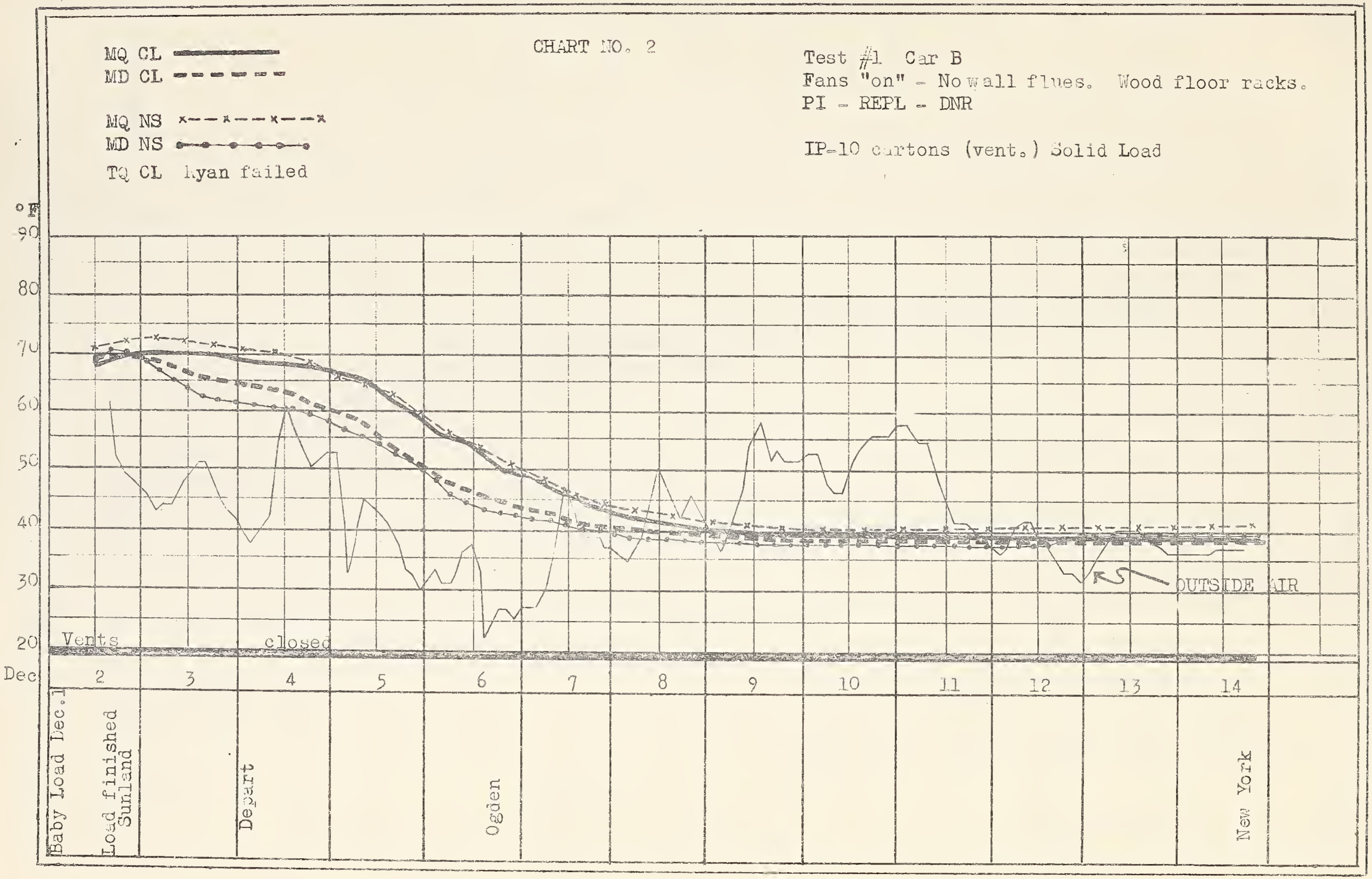
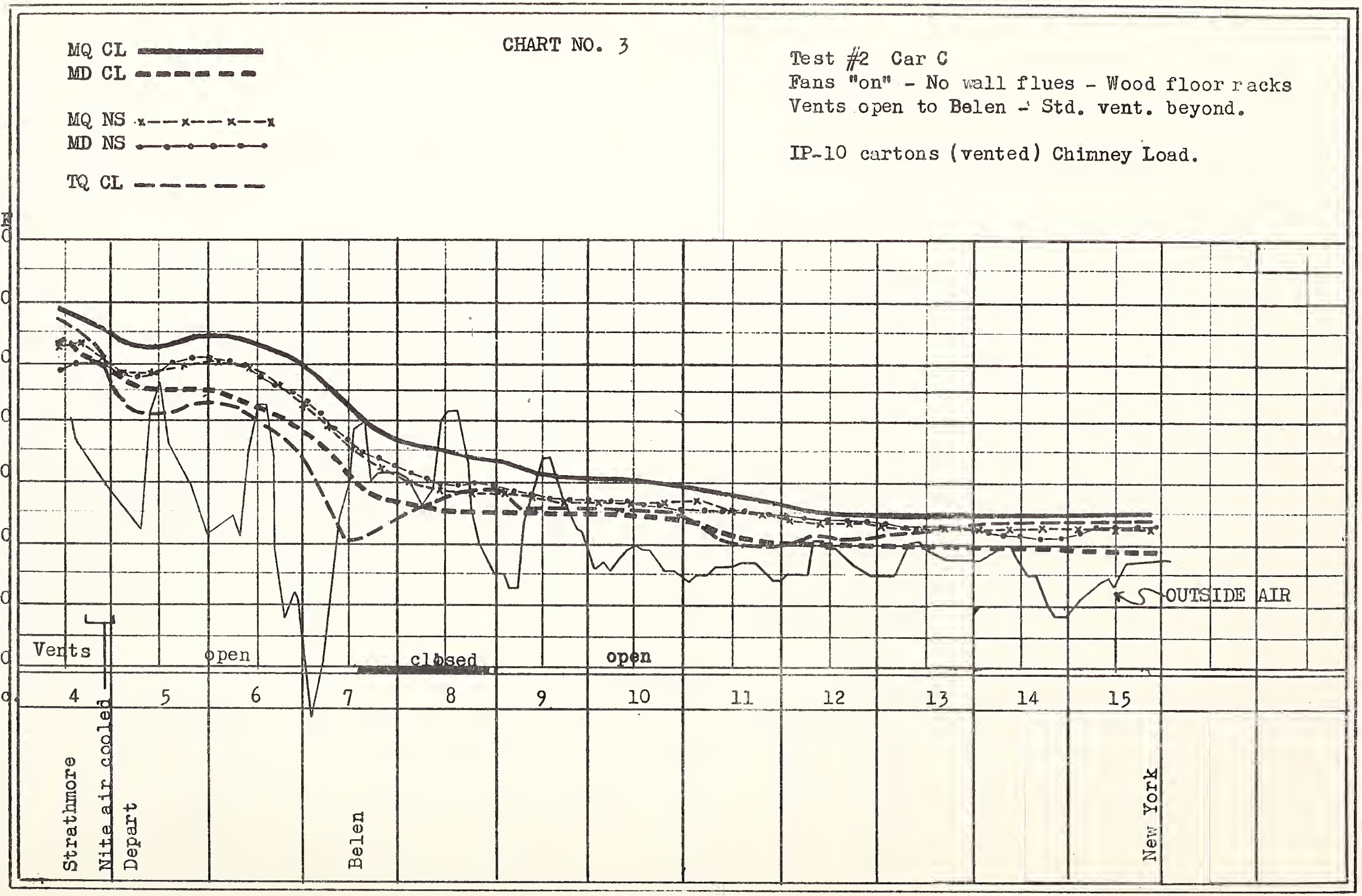


CHART NO. 2

Test #1 Car B
Fans "on" - No wall flues. Wood floor racks.
PI - REPL - DNR

IP-10 cartons (vent.) Solid Load

CHART NO. 3



Test #2 Car C
Fans "on" - No wall flues - Wood floor racks
Vents open to Belen - Std. vent. beyond.

IP-10 cartons (vented) Chimney Load.

CHART No. 4

Test #2 Car D.
Fans "on" - No wall flues - Metal floor racks.
Vents open to Belen - Std. vent. beyond.

IP-10 cartons (vented) Loaded solid on end.

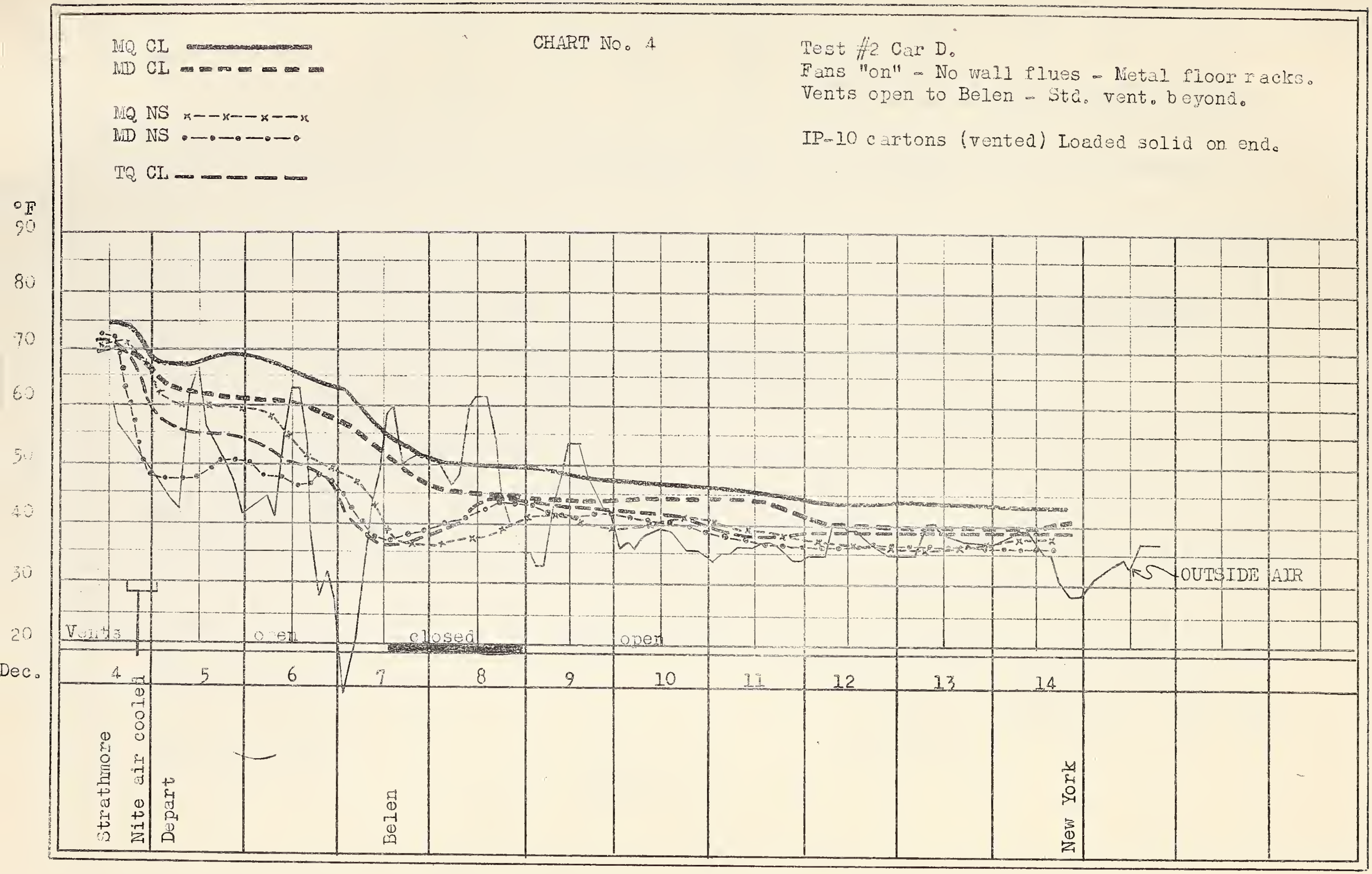
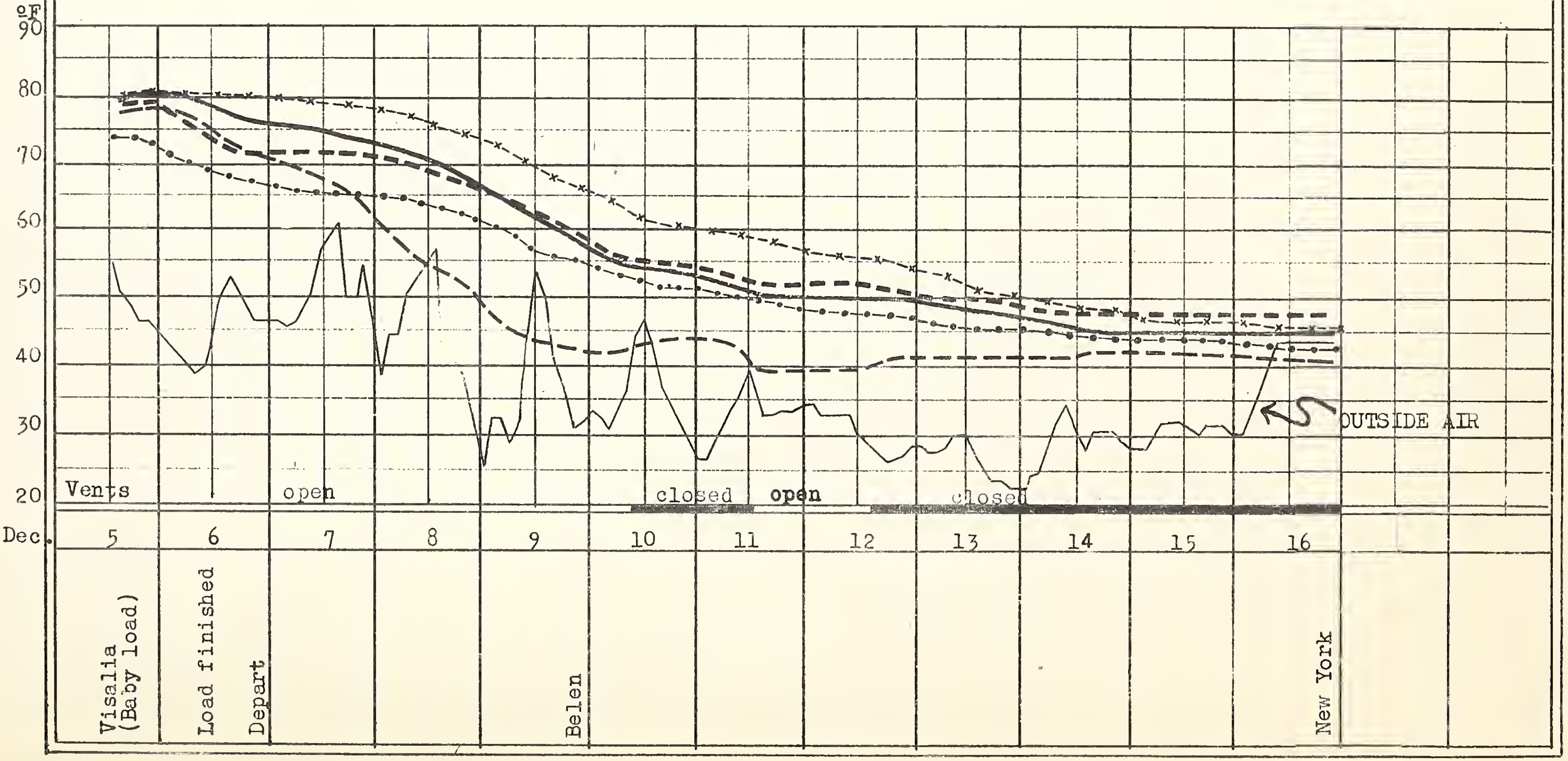


CHART NO. 5.

Test #3 Car E.
Fans "on" - No wall flues - Wood floor racks.
Vents open to Belen - Std. vent. beyond.

IP-10 cartons (vented) Chimney Load.



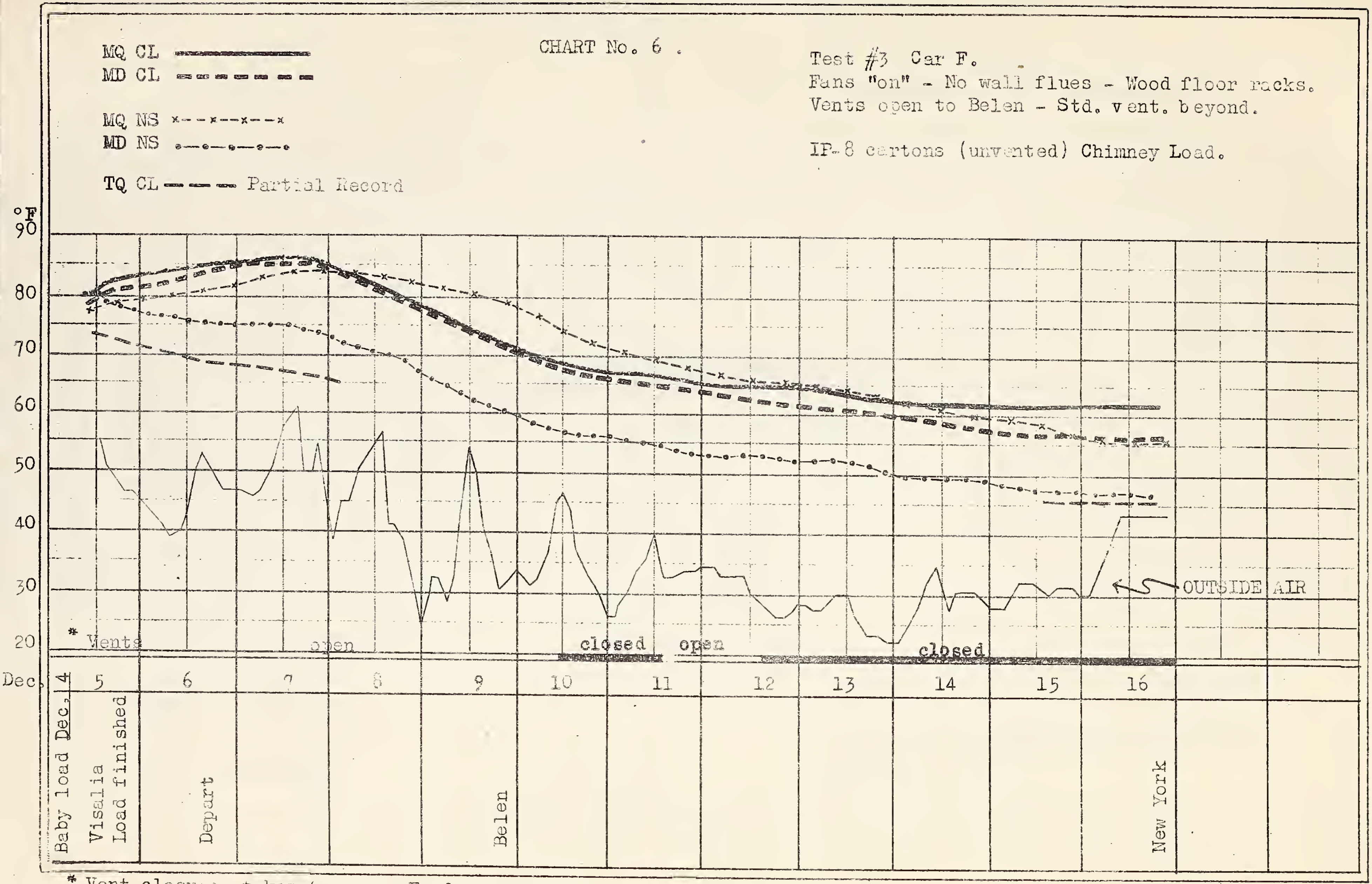


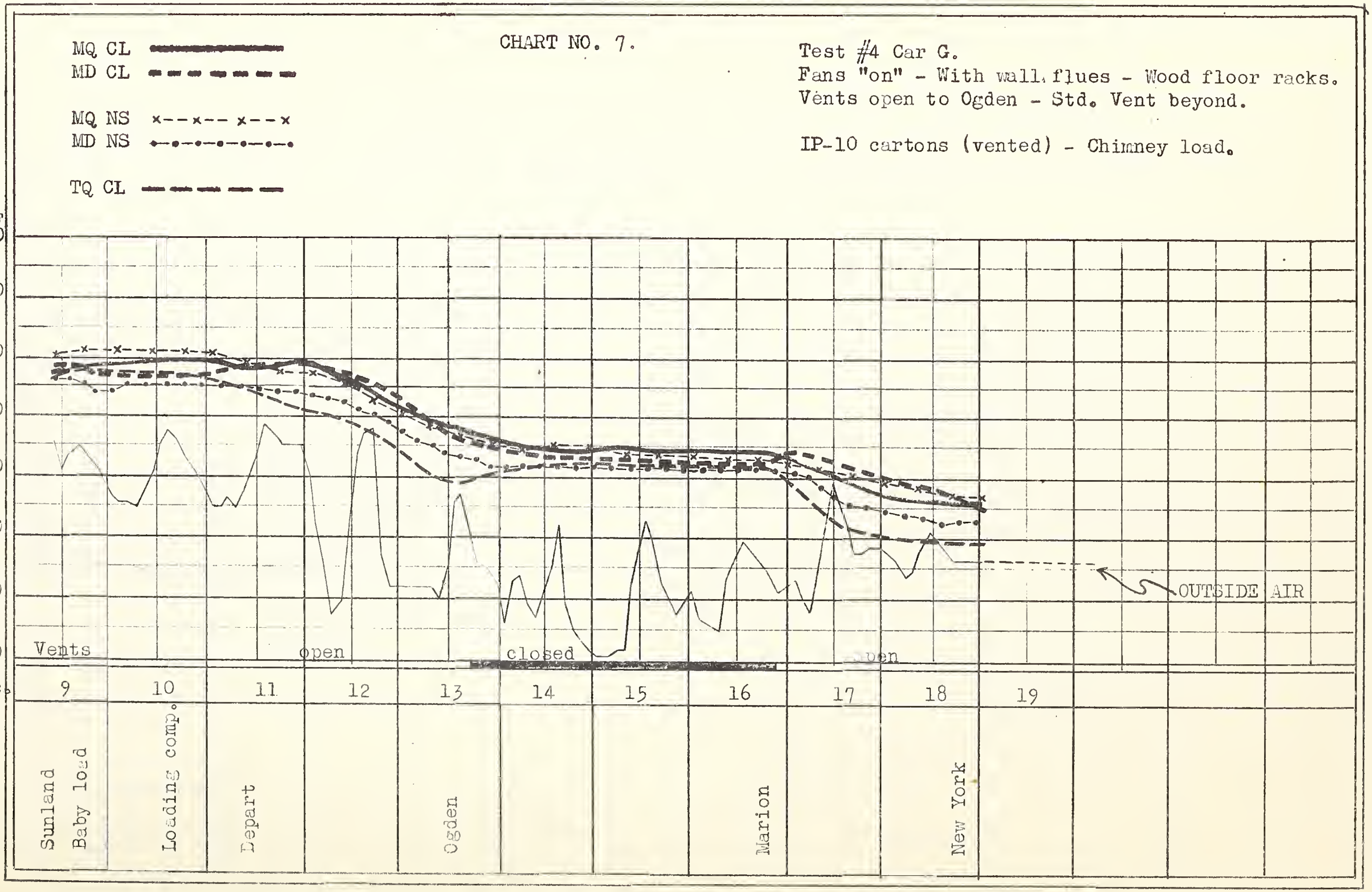
CHART No. 6 .

Test #3 Car F.
Fans "on" - No wall flues - Wood floor racks.
Vents open to Belen - Std. vent. beyond.

IP-8 cartons (unvented) Chimney Load.

* Vent closures taken from car E of same test.

CHART NO. 7.



Test #4 Car G.
Fans "on" - With wall flues - Wood floor racks.
Vents open to Ogden - Std. Vent beyond.

IP-10 cartons (vented) - Chimney load.

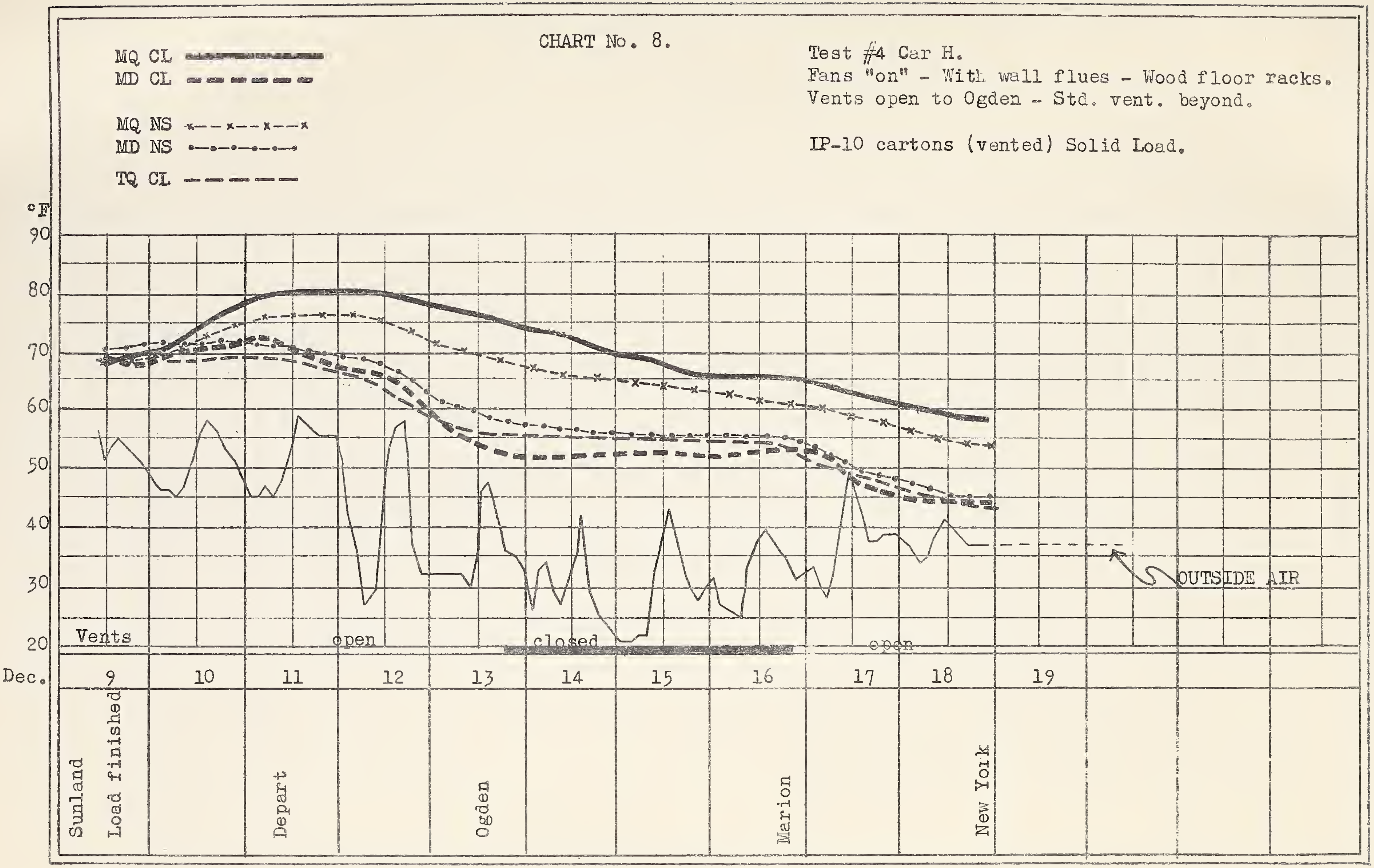


CHART No. 8.

Test #4 Car H.
Fans "on" - With wall flues - Wood floor racks.
Vents open to Ogden - Std. vent. beyond.

IP-10 cartons (vented) Solid Load.

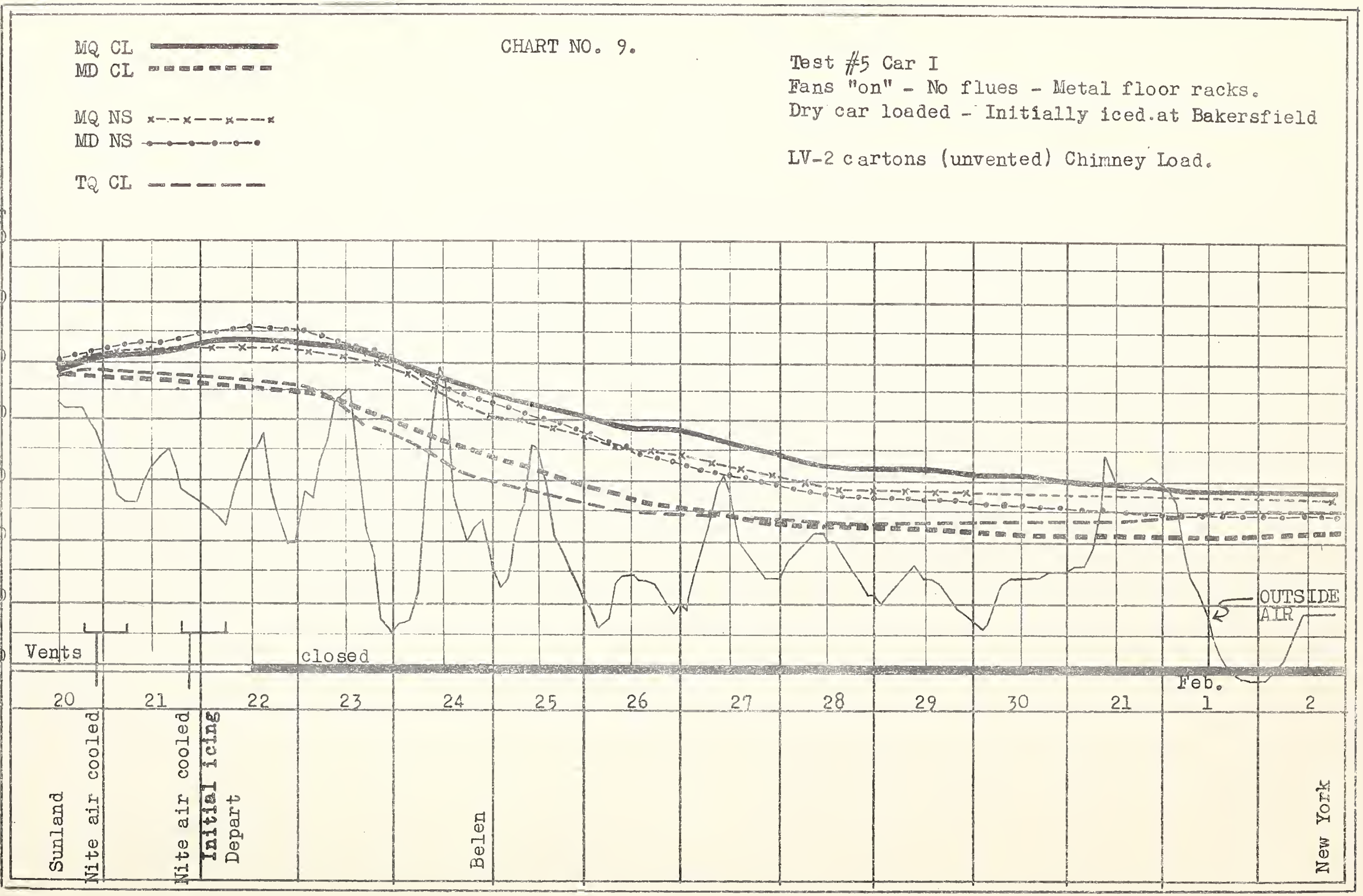
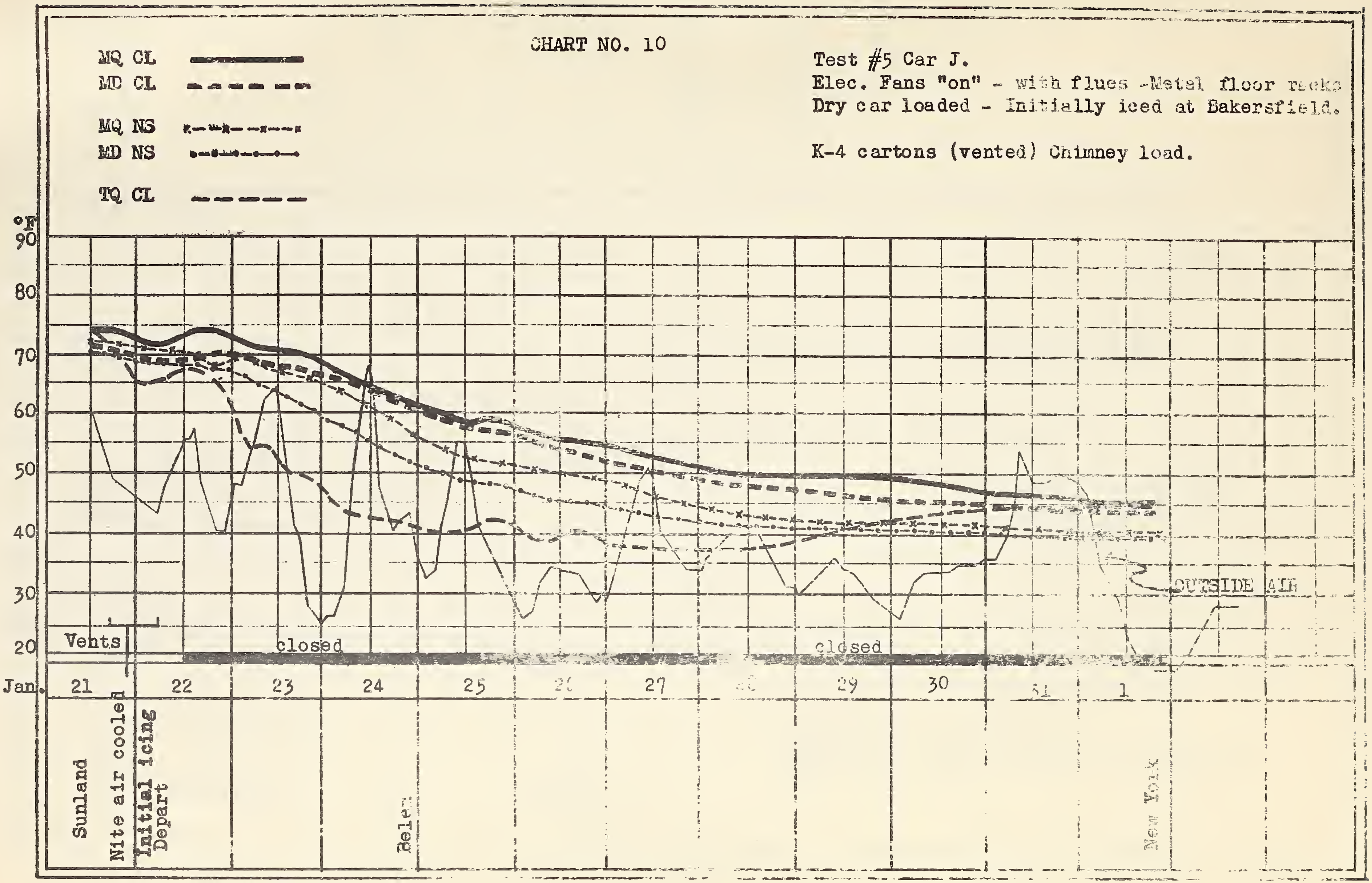


CHART NO. 9.

Test #5 Car I
Fans "on" - No flues - Metal floor racks.
Dry car loaded - Initially iced at Bakersfield

LV-2 cartons (unvented) Chimney Load.

CHART NO. 10


Test #5 Car J.
Elec. Fans "on" - with flues -Metal floor racks
Dry car loaded - Initially iced at Bakersfield.

K-4 cartons (vented) Chimney load.

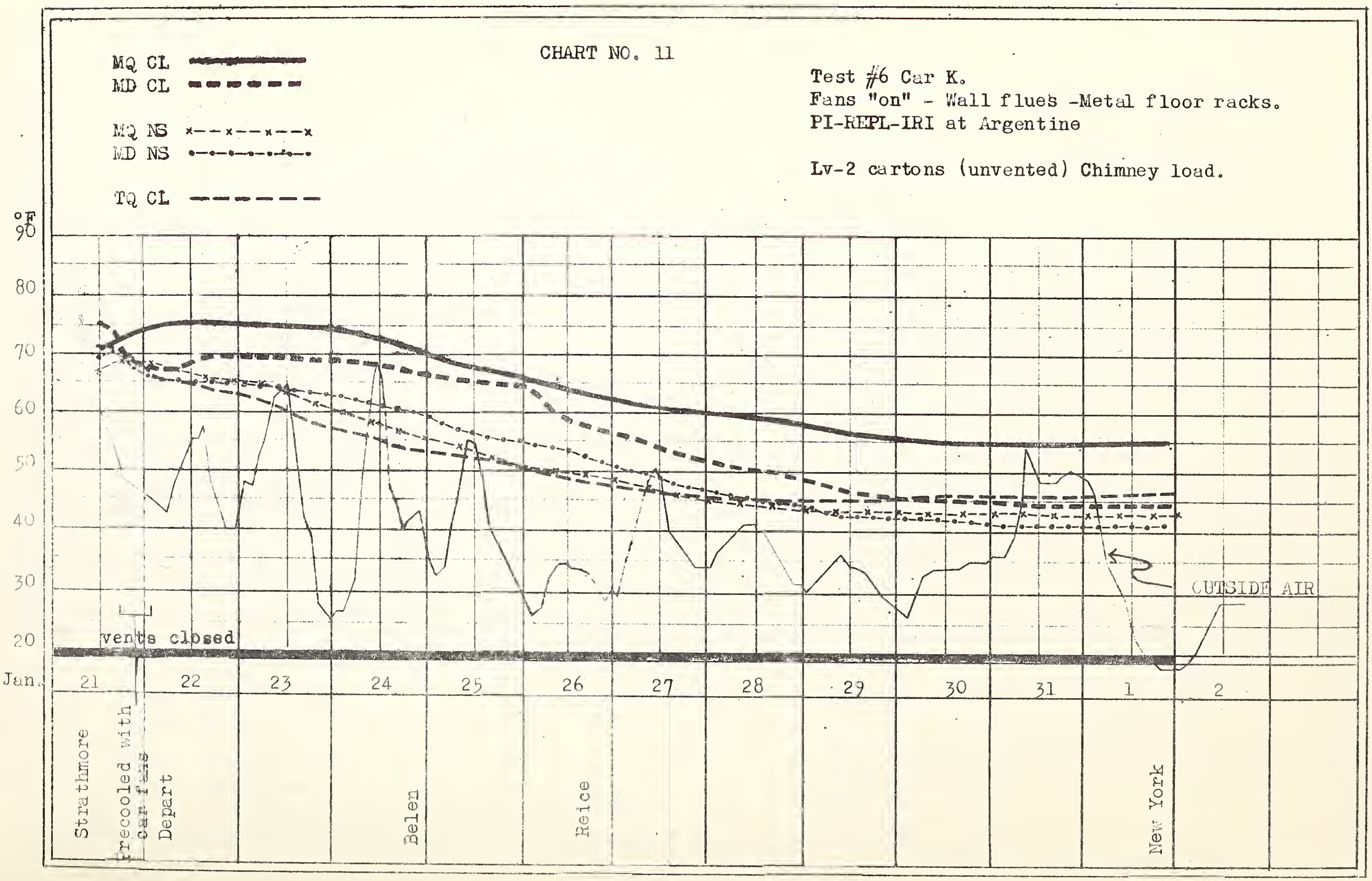
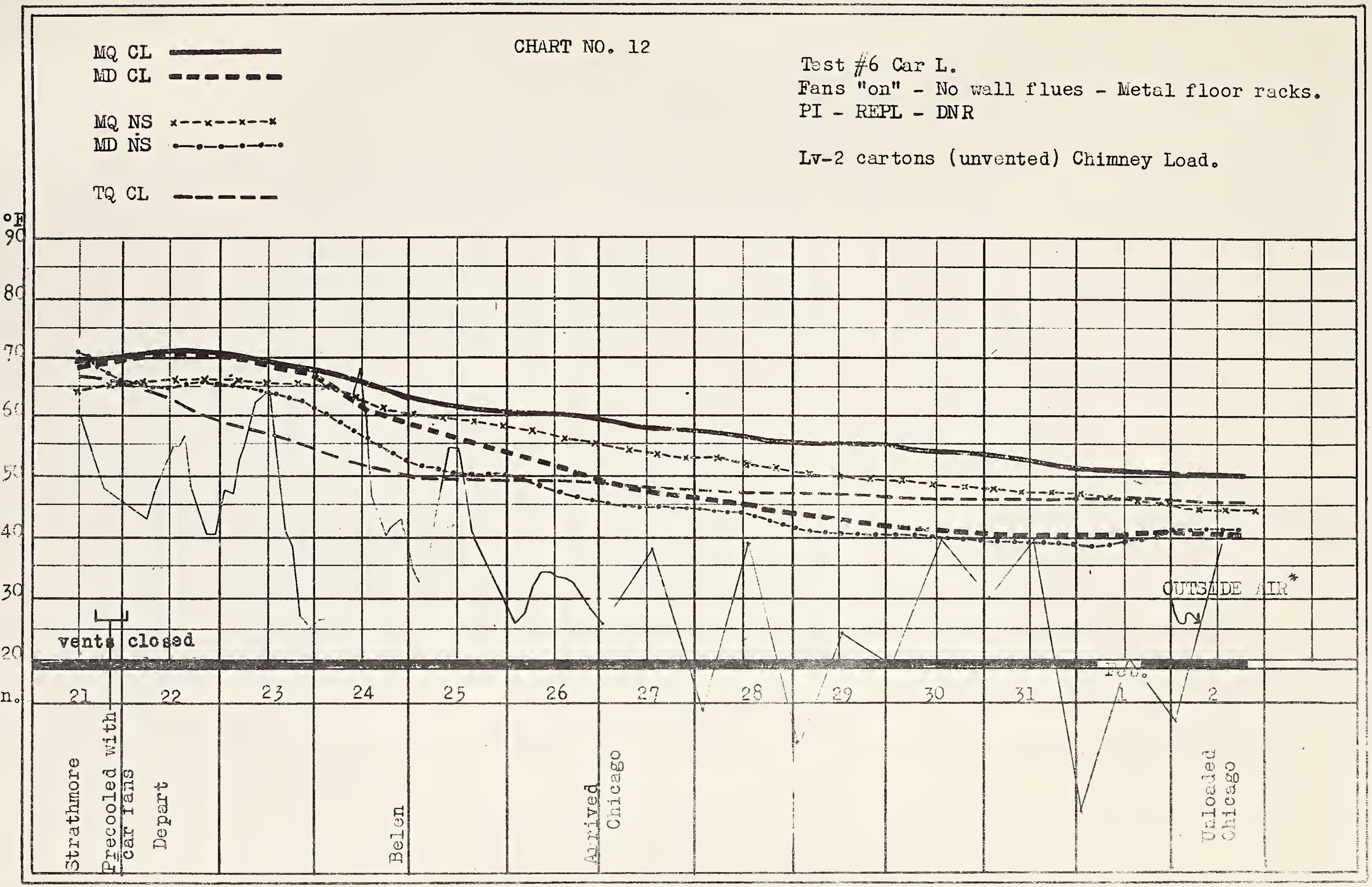


CHART NO. 11

Test #6 Car K.
Fans "on" - Wall flues -Metal floor racks.
PI-REPL-IRI at Argentine

Lv-2 cartons (unvented) Chimney load.

CHART NO. 12



Test #6 Car L.
Fans "on" - No wall flues - Metal floor racks.
PI - REPL - DNR

Lv-2 cartons (unvented) Chimney Load.

* Only Maximum & Minimum Outside Temp. available after arrival at Chicago.

MIDDLE QUARTER CENTERLINE (MQ CL) TEMPERATURES IN TRANSIT

CHART NO. 13